

EXHIBIT “A”

THE TRUSTEES OF THE STEVENS INSTITUTE OF TECHNOLOGY
CORPORATE SPONSORED RESEARCH AGREEMENT

October ^{hrs} *MW Bkt 10.120*
This is a **RESEARCH AGREEMENT** effective **September 1, 2020**, by and between
The Trustees of the Stevens Institute of Technology, a non-profit corporation organized and
existing under the laws of the State of New Jersey (the "University") and iModaGround,
LLC, a Delaware limited liability company, having its principal offices at 112 S. 24th Street,
Weirton, West Virginia 26062 (the private "Sponsor") and Inter-Modal Holding, LLC, an
Ohio limited liability company, having its principal offices at 117 S. Hollywood Blvd,
Steubenville, Ohio 43952 (the private "Advocate").

WITNESSETH:

WHEREAS, in pursuit of its educational purposes, which include research and
training, the University undertakes scholarly, research, and experimental activities in a
variety of academic disciplines; and

WHEREAS, the private Sponsor, with its private Advocate, wish to fund and desire
that the University undertake a research program in the field of **Maritime and Aviation**
Low Cost Sensors as described more fully in **Exhibit A**, attached hereto; and

WHEREAS, in furtherance of its scholarly, research, and instructional interests, the
University is willing to undertake such research upon the terms and conditions set forth
below;

NOW, THEREFORE, in consideration of the premises and the mutual covenants
herein contained, the parties hereto agree as follows:

1. Scope of Research. During the term of this Agreement, the University shall use
reasonable efforts to perform the research program described in **Exhibit A**, attached
hereto and which hereby is incorporated herein (the "Research"). Notwithstanding the
foregoing, the University makes no warranties or representations regarding its ability to

achieve, nor shall it be bound hereby to accomplish, any particular research objective or results.

2. Personnel.

(a) The Research shall be performed by and under the supervision and direction of **Dr. Hady Salloum**, while employed by the University, who shall be designated the principal investigator, together with such additional personnel as may be assigned by the University. The University shall give Sponsor written notice of any change in its Principal Investigator, subject to Sponsor's approval, which shall not unreasonably be withheld. If the parties cannot agree on a successor, either party may terminate this Agreement in accordance with the terms of Section 10.

(b) It is understood that the University and the personnel performing the Research hereunder may be involved in other activities and projects which entail pre-existing commitments to other sponsors. The University will use reasonable efforts to avoid conflicts with the terms of this Agreement; however, it is agreed that unless provided to the contrary herein, this Agreement is subject to the University's pre-existing commitments to such other sponsors.

3. University Policies and Procedures. (a) All Research conducted hereunder shall be performed in accordance with established University policies and procedures, including, but not limited to, policies and procedures applicable to research involving human subjects, laboratory animals, and conflicts of interest.

(b) Nothing in this Agreement shall be construed to limit the freedom of the University or of its researchers who are not participants under this Agreement, from engaging in similar research made under other grants, contracts or agreements with parties other than the Sponsor.

4. Fixed Price.

(a) The Sponsor shall pay the University in the amounts and according to the schedule set forth in the budget set forth as Exhibit B attached hereto and which hereby is incorporated herein; provided, however, that the University may submit to Sponsor at any time, and Sponsor may at its discretion approve in writing, a revised budget or budgets requesting additional funds. In the event that the Sponsor requests any modification to the Research, the parties will negotiate to consider such modification and the resulting modifications to the budget. The University shall have the authority to rebudget Costs from time to time, at the discretion of the Principal Investigator, as long as the rebudgeting is consistent with the goals of the Research Program.

(b) The Sponsor shall make advance payments to the University as set forth in Exhibit B. All checks shall be made payable to The Trustees of the Stevens Institute of Technology, shall include reference to the Principal Investigator, and shall be sent to:

Office of Sponsored Accounting

Office of Finance

The Trustees of the Stevens Institute of Technology
One Castle Point on Hudson, Howe Center, 11th Floor
Hoboken, New Jersey 07030

Or wired to:

PNC Bank NA

Two Tower Center Boulevard

East Brunswick, NJ 08816

Bank account name: Stevens Institute of Technology

IBAN Number: [REDACTED]

Swift Number: [REDACTED]

Routing Number: [REDACTED]

Reference: Dr. Hady Salloum

(c) The University is a nonprofit 501(c) (3) corporation. Sponsor agrees that if this Agreement is subject to taxation by any governmental authority, Sponsor will pay these taxes in full and the University will have no liability for the payment of these taxes.

5. Research Reports. The University shall furnish to Sponsor during the term of this Agreement periodic informal reports regarding the progress of the Research. A final report setting forth the significant research findings shall be prepared by the University and submitted to Sponsor within a reasonable period following the expiration of the term of this Agreement or the effective date of early termination.

6. Publication.

(a) Part of the University's mission is to publish and disseminate research results developed under sponsored research projects. Consistent with this Agreement, the University, its principal investigator and other University employees and/or students may disseminate or publish the results of the Research without prior approval by the Sponsor. The University shall provide the Sponsor with a copy of any proposed publication 30 days in advance of submission to third parties. The Sponsor shall determine whether any of its Confidential Information is included in the proposed publication. The Sponsor may reasonably require that any of its Confidential Information be removed from the proposed publication. The Sponsor may reasonably require that publication be delayed to permit the filing of patent applications. The Sponsor shall make such determinations within thirty (30) days of receipt of the proposed publication. Publication shall not be delayed more than ninety (90) days after receipt of the proposed publication by the Reviewing Party. The Sponsor at its election shall be entitled to receive an acknowledgment of its sponsorship of the Research in any such publication.

(b) The University shall have the final authority to determine the scope and content of any publications or presentations made by its students and employees in accordance with the limitations of this section.

7. Confidential Information.

a) Confidential Information consists of information that has been reduced to writing and marked "Confidential," or, if disclosed orally, has been reduced to writing and marked "Confidential" within thirty (30) days of oral disclosure, and in the case of delivery to the University shall be delivered only to the Vice Provost for Research. Subject to the following exceptions, all confidential information of the either party disclosed by it to the other party in connection with the Research hereunder will be treated as confidential throughout the term hereof or for three years, whichever is longer. Each party will use reasonable efforts to safeguard the confidentiality of the other Party's Confidential Information, and will require its employees, students and associates to adhere to such obligation of confidentiality. The following shall be exceptions to confidentiality:

- (i) Information that is now in the public domain or subsequently enters the public domain through no fault of the receiving party;
- (ii) Information that is presently known or becomes known to the receiving party from its own independent sources;
- (iii) Information that the receiving party receives from any third party not under any obligation to keep such information confidential;
- (iv) Information that is required to be disclosed by law.
- (v) Information that is developed independently by persons who had no direct or indirect access to the information.

b) Neither Party shall knowingly convey Confidential Information that is subject to federal export control restrictions under the EAR or the ITAR without first so disclosing to the other Party and providing the other Party the opportunity to decline receiving such information.

8. Intellectual Property.

(a) **Ownership of Technology.** The University owns the entire right, title, and interest, including all patents, copyrights, and other intellectual property rights, in and to all technology developed using University facilities and by University personnel ("University Technology") under this Agreement. Sponsor owns all interests, including all patents, copyrights, and other intellectual property rights, in and to all technology developed using

Sponsor facilities and by Sponsor personnel ("Sponsor Technology"). Technology that is jointly developed by University and Sponsor personnel will be jointly owned ("Joint Technology") and the parties will not commercialize any such Joint Technology without first entering into a written agreement providing for such terms as allocation of revenue, appropriate use of the names of the parties, disclaimers and indemnification and insurance coverage.

(b) Disclosure and Right to Patent Inventions. The University and Sponsor shall promptly disclose to each other in writing any invention first conceived or discovered in the performance of the Research in the field of the Research, and reported to the University's Office of Innovation and Entrepreneurship or Sponsor's Intellectual Property Authority ("IPA") (see Article 11 "Notices"), respectively. Such disclosure shall be considered Confidential Information. The University may file patent applications at its own discretion and expense, or at the request of Sponsor at Sponsor's expense. If Sponsor elects to license the Technology, Sponsor will pay for the costs of patent filing, prosecution and maintenance in the United States and any foreign country. Sponsor will notify the University of those countries outside the United States in which it desires a license in sufficient time for the University to satisfy the patent-law requirements of those countries. Sponsor will reimburse the University for out-of-pocket costs for those filings, including patent filing, prosecution, and maintenance fees. The Sponsor shall have the sole right to file and prosecute a patent application on any Sponsor Invention.

(c) Option. For each University Invention or Joint Invention, the Sponsor will have the option, for a period of three months from the date of disclosure to Sponsor, to elect to negotiate for a royalty-bearing, exclusive or non-exclusive, world-wide license to the University's rights in such invention, including in the case of an exclusive license the right to sublicense under certain circumstances, to make, have made, use, lease, sell, import and export products embodying or produced through the use of such invention (the "Option"). In the event that the parties are unable to reach agreement on the terms of the license described above after three months of good faith negotiations, and the parties therefore do not execute such license, the University shall have no further obligations to the Sponsor and may enter into an agreement relating to such patent or patent application with any third party.

(d) **License.** Any license to Sponsor as provided herein will be granted pursuant to a separate license agreement signed by the parties which shall include at least the following terms and conditions: (a) an appropriate field of use; (b) mutually agreeable license fees and royalties; (c) mutually agreeable minimum royalties and/or other requirements of due diligence to develop and effectively commercialize the Invention; (d) reimbursement of University's cost of patent filing, prosecution and maintenance; (e) retention by University of a royalty-free right, sublicensable to its research partners, to use the Invention for teaching, research, or other educational or academic purposes; (f) no-warranty provisions, indemnification of the University and product liability and contractual liability insurance coverage for the benefit of the University, in addition to other customary terms and provisions; and (g) demonstration of reasonable efforts to commercialize the Technology in the public interest and accomplish certain milestones.

(e) **Option for Copyright License.** Sponsor may elect to negotiate a nonexclusive or exclusive (subject to third party rights, if any) royalty-bearing license to use, reproduce, display, distribute and perform computer software and its documentation for commercial purposes in a designated field of use. Sponsor must make such election within 3 months of notice of the University's disclosure of copyrightable material available for license.

(f) **Data.** University will retain ownership of the data arising out of the Research that University generates. Subject to other provisions of this Agreement, including those pertaining to confidential information and intellectual property, Sponsor will have access to the data and may use such data in connection with its internal research, subject to the appropriate provisions for confidentiality.

(g) **Tangible research property.** University shall retain ownership of property that is developed solely by University's employees, students, and agents, including, but not limited to, prototypes, biogenic materials, samples, lab notebooks graphs, maps, drawings, and documents created or acquired under this Agreement (collectively, "Tangible Research Property"). University shall not retain ownership of tangible research property that is a deliverable under this Agreement. University shall retain the right to use and distribute copies of all deliverables for educational and/or research purposes.

(h) **Copyrightable material.** As between University and Sponsor, University shall own all right, title and interest in and to any and all copyrights and copyrightable materials, including data, that is created solely by University employees, students or agents in performance of this Agreement (collectively "University Copyrights"). As between University and Sponsor, Sponsor shall own all right, title and interest in and to any and all copyrights and copyrightable materials, including data, created solely by Sponsor employees or agents in performance of this Agreement (collectively, "Sponsor Copyrights"). As between University and Sponsor, University and Sponsor shall jointly own all right, title and interest in and to any and all copyrights and copyrightable materials, including data, created jointly by University employees, students, or agents and Sponsor employees or agents in performance of this Agreement (collectively, "Joint Copyrights"). University shall have the sole right to determine the disposition of University Copyrights, provided that Sponsor shall have option rights, in accordance with Section 8, in computer software and databases developed and delivered as part of the Research Program.

(i) **Background IP.** Neither Party shall, by virtue of this Agreement, acquire rights to inventions, copyrights, technical information, or tangible property concurrently created or acquired outside of this Agreement or that are owned by the other Party prior to entering into this Agreement, including any background technology required to practice Inventions. Such rights may or may not be available for licensing.

9. Ownership of Property. Title to any equipment purchased or created in the performance of the work funded under this Agreement shall vest in the University.

10. Term and Termination.

October

*MM BHT
10-1-20*

MM HRS
3/1/20
(a) This Agreement shall be effective for the term **September 1, 2020 through December 31, 2021**, and may be extended thereafter by mutual agreement of the parties in writing; provided, however, that the Termination of this Agreement shall not relieve either party of any obligation of such party accrued prior to such termination hereunder.

In particular, the provisions hereof relating to rights in patents and ownership of property shall survive such termination.

(b) Notwithstanding the foregoing, this Agreement may be terminated by either party at any time upon 60 days advance written notice to the other party. Upon receipt of notice of early termination by Sponsor, the University shall use reasonable efforts promptly to limit or terminate any outstanding commitments prior to the effective termination date.. All allowable costs associated with such termination and up through the date of termination, shall be reimbursed by Sponsor, including non-cancelable commitments.

(c) If Sponsor breaches its obligation of payment and fails to remedy such breach within thirty (30) days after receipt of notice in writing of such breach , the University may, in addition to any other remedies that the University may have in law or in equity, terminate this Agreement by sending written notice of termination to Sponsor. Termination for material breaches will be effective from the date of notice to the Sponsor and do not affect any of University's other rights under this Agreement.

(d) The terms of Sections 11 – 19 shall survive any termination of this Agreement.

11. Notices. Any notices given under this Agreement shall be in writing and shall be deemed delivered when sent by first-class mail, postage prepaid, addressed to the parties as follows (or at such other addresses as the parties may notify each other in writing):

The University

Barbara DeHaven
Office of Sponsored Programs
One Castle Point on Hudson
Hoboken, NJ 07030
awards@stevens.edu

The Private Sponsor

Contracts
iModalGround, LLC
112 S. 24th Street
Weirton, WV 26062
imodalground@gmail.com

Provided, however, that Invention Disclosures shall be addressed to the parties as follows:

The University

David Zimmerman
Office of Innovation & Entrepreneurship
One Castle Point on Hudson
Hoboken, NJ 07030
David.zimmerman3@stevens.edu

The Private Sponsor IPA

Contracts
iModalGround, LLC
112 S. 24th Street
Weirton, WV 26062
imodalground@gmail.com

12. Use of Name: Press Releases. (a) University Name. Sponsor will not identify the University in any promotional statement, or otherwise use the name of any University faculty member, employee, or student, or any trademark, service mark, trade name, or symbol of the University, including the University's name, unless Sponsor has received prior written consent from an officer of the University. Permission may be withheld at the sole discretion of the University.

(b) Sponsor Name. The University will not identify Sponsor in any promotional statement, or otherwise use the name of any Sponsor employee, or any trademark, service mark, trade name, or symbol of Sponsor, including Sponsor's name, unless the University has received Sponsor's prior written consent. Permission may be withheld at the sole discretion of the Sponsor.

(c) Neither party will issue a press release or other announcement about the Research without the prior written approval of the other party.

13. Relationship of the Parties. The relationship of Sponsor and the University established by this Agreement is that of independent contractors. Nothing in this Agreement shall be construed to create a relationship of employment or agency, nor shall either party's employees, servants, agents, or representatives be considered the employees, servants, agents, or representatives of the other. Nothing in this Agreement shall be construed to constitute the parties as partners or joint venturers, or allow either of the parties to create or assume any obligation on behalf of the other party.

14. Indemnification. The Sponsor hereby defends, indemnifies and holds harmless the University, the Principal Investigator, and any of University's faculty, students, employees, trustees, officers, affiliates, and agents (hereinafter referred to collectively as the "Indemnified Persons") from and against any and all liability, claims, lawsuits, losses, damages, costs or expenses (including reasonable attorneys' fees), which the Indemnified Persons may hereafter incur, or be required to pay arising from or related to the Sponsor's use of the Research or any Technology, data or research results. University shall notify Sponsor upon learning of the institution or threatened institution of any such liability, claims, lawsuits, losses, damages, costs and expenses and University shall cooperate with Sponsor in every proper way in the defense or settlement thereof at Sponsor's request and expense with counsel selected by Sponsor and reasonably satisfactory to the University. Sponsor shall not dispose or settle any claim admitting liability on the part of the University without the University's prior written consent.

15. NO WARRANTIES. THE UNIVERSITY MAKES NO WARRANTIES OF ANY KIND EITHER EXPRESS OR IMPLIED, AS TO ANY MATTER, INCLUDING, WITHOUT LIMITATION, THE RESEARCH OR ANY INTELLECTUAL PROPERTY RIGHTS OR PRODUCTS, TANGIBLE OR INTANGIBLE, CONCEIVED, DISCOVERED, OR DEVELOPED UNDER THIS AGREEMENT; OR THE OWNERSHIP, NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE OF THE RESEARCH RESULTS OR OF ANY SUCH INVENTION OR PRODUCT; OR THE ABSENCE OF LATENT OR OTHER DEFECTS, WHETHER OR NOT DISCOVERABLE. IN NO EVENT SHALL EITHER PARTY, ITS TRUSTEES, DIRECTORS, OFFICERS, EMPLOYEES, STUDENTS OR AFFILIATES BE LIABLE FOR INDIRECT, CONSEQUENTIAL, LOST PROFITS, OR OTHER DAMAGES SUFFERED BY THE OTHER PARTY OR BY ANY LICENSEE OR ANY OTHERS, REGARDLESS OF WHETHER THE PARTY WAS ADVISED, HAD OTHER REASON TO KNOW OR IN FACT KNEW OF THE POSSIBILITY OF THE FOREGOING, RESULTING FROM THE USE OF THE RESEARCH RESULTS, INCLUDING ANY INVENTION, PROGRAM, OR PRODUCT.

16. Export Controls. The University complies with all applicable laws and regulations, including, where applicable, federal export control regulations. Many of the University employees (faculty and staff) and students are residents of foreign countries, including individuals who may work on this contract and/or have access to information conveyed to the University pursuant hereto. The University does not screen its employees or students based on nationality. In most situations, the University relies on the fundamental research exclusion from export control laws, but makes no representation as to whether Sponsor's conveyance of information or material to the University pursuant hereto would be covered by the export control laws.

Sponsor will not knowingly disclose, and will use commercially reasonable efforts to prevent disclosure to the University, of any information subject to ITAR controls or on the Commerce Control List, Restricted Data or Sensitive Nuclear Technology. If, for purposes of the Research, Sponsor intends to disclose export-controlled information to the University, Sponsor will not disclose such information to the University unless and until a plan for transfer, use, dissemination and control of the information has been approved by the University. In the event Sponsor inadvertently (i) discloses export controlled information or (ii) breaches this Section, any deadlines contemplated by the Statement of Work will be adjusted based upon the time it takes to address the disclosure.

17. Force Majeure. The University shall not be liable for any failure to perform as required by this Agreement, to the extent such failure to perform is caused by any reason beyond the University's control, or by reason of any of the following; labor disturbances or disputes of any kind, accidents, failure of any required governmental approval, civil disorders, acts of aggression, acts of God, energy or other conservation measures, failure of utilities, mechanical breakdowns, material shortages, disease, or similar occurrences.

18. Assignment. Neither the University nor the Sponsor shall assign this Agreement to any other person without the prior written consent of the other, and any purported assignment without such consent shall be void.

19. Severability. In the event that a court of competent jurisdiction holds any provision of this Agreement to be invalid, such holding shall have no effect on the remaining provisions of this Agreement, and they shall continue in full force and effect.

20. Entire Agreement; Amendments. This Agreement and the Exhibits hereto contain the entire agreement between the parties. No amendments or modifications to this Agreement shall be effective unless made in writing and signed by authorized representatives of both parties.

21. Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of New Jersey. The courts of the State of New Jersey in Hudson County and the United States District Court for the District of Newark shall have exclusive jurisdiction over the parties with respect to any dispute or controversy between them arising under or in connection with this Agreement and, by execution and delivery of this Agreement, the parties to this Agreement submit to the jurisdiction of those courts, including, but not limited to, the in personam and subject matter jurisdiction of those courts, waive any objection to such jurisdiction on the grounds of venue or forum non conveniens, the absence of in personam or subject matter jurisdiction and any similar grounds, consent to service of process by mail in accordance with Section 11 or any other manner permitted by law and irrevocably agree to be bound by any such judgment rendered thereby in connection with this Agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement by their duly authorized officers or representatives.

**THE TRUSTEES OF THE STEVENS
INSTITUTE OF TECHNOLOGY**

**THE PRIVATE SPONSOR:
IMODALGROUND, LLC**

By Barbara DeHaven
Barbara DeHaven
Title Executive Director
Date 9/30/2020

By M. Johnson
Title President
Date 9/30/20

Read and acknowledged:

Principal Investigator

Salloum

Name: Hady Salloum

Stevens Institute of Technology

STATEMENT OF WORK

**Research for the Commercialization of the Passive Acoustic
Underwater Intruder Detection System**

Title of Proposal: **Research for the Commercialization of the Passive Acoustic
Underwater Intruder Detection System**

Submitted to: iModalGround, LLC

Submitted by: The Trustees of Stevens Institute of Technology

TIN: 22-1487354

DUNS: 064271570

Institutional Address: The Trustees of the Stevens Institute of Technology
One Castle Point on Hudson
Hoboken, New Jersey 07030

Telephone: 201-216-5000

Fax Number: 201-216-5537

Principal Investigator: Hady Salloum, PhD

Title: Research Professor and Director,
Sensor Technology and Applied Research (STAR) Center
Director, DHS National Center for Maritime Security (MSC)

School: Schaefer School of Engineering & Science

Department: Electrical and Computer Engineering

Campus Address: Babbio Center, 6th Floor
Hoboken, New Jersey 07030

Telephone: 201-216-8575

Amount Requested: \$3,300,000

Proposed Start Date: October 1, 2020

Proposed End Date: March 31, 2022

Stevens Institute of Technology

STATEMENT OF WORK

**Research for the Commercialization of the Passive Acoustic
Underwater Intruder Detection System**

- - - EXHIBIT A - - -

STATEMENT OF WORK

for

**Research for the Commercialization of the Passive Acoustic
Underwater Intruder Detection System**

Sponsored Research Agreement

The Trustees of Stevens Institute of Technology

Stevens Institute of Technology**STATEMENT OF WORK****Research for the Commercialization of the Passive Acoustic
Underwater Intruder Detection System****TABLE of CONTENTS**

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Stevens Institute of Technology

STATEMENT OF WORK

Research for the Commercialization of the Passive Acoustic Underwater Intruder Detection System

1 BACKGROUND

1.1 PROJECT OBJECTIVES

This Statement of Work outlines an approach for Stevens Institute of Technology (SIT) to take its existing patented Stevens Passive Acoustic Detection System (SPADES), which is currently an engineering prototype, and move it through the engineering development and test cycles so that it is production worthy for manufacturing and commercialization. SPADES sensor system may be arranged in several acoustic arrays, with each of them having four or more hydrophones (see Figure 1). This low cost, easily deployable sensor system is of great interest to the marine industry for safety, security characterization and classification of vessels, boats, and swimmers in/around marine assets (ports, terminals, waterways, etc.). The system is novel because it allows for easy deployment along with non-intrusive installation and operations.

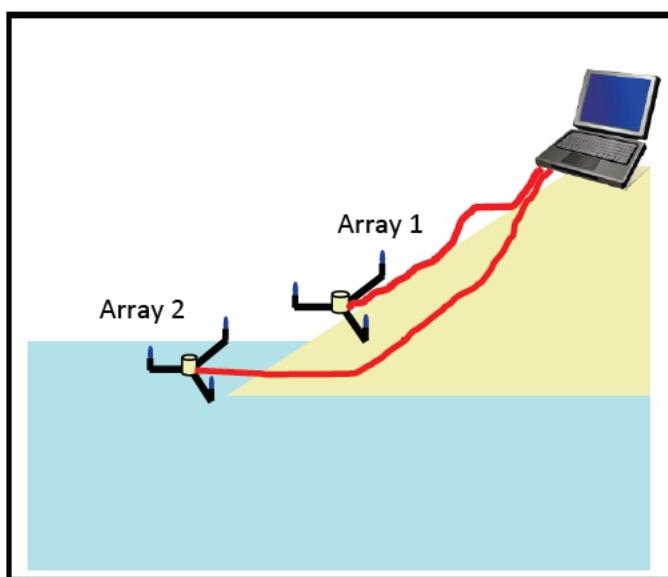


Figure 1. A schema of SPADES with two acoustic arrays. Each array can provide target detection and direction finding.

SIT, including the DHS Center of Excellence (the Maritime Security Center or MSC) and the Sensor Technology and Applied Research (STAR) Center, would participate to develop the beta version of SPADES, manage the testing and oversee getting a preproduction version developed. Assessment reviews will be conducted to ensure requirements are being met.

An interdisciplinary team from SIT will carry out this project under the direction of Dr. Hady Salloum, Professor of Electrical and Computer Engineering in the Schaefer School of Engineering & Science, Director of the STAR Center, and Director of MSC. This project integrates within a larger project sponsored by iModalGround, LLC (IMG) which involves IMG's Visual Classification System (VICS) along with a marine test environment located at a Lock & Dam on the Lower Monongahela River in Morgantown, West Virginia.

The overarching goal is to mature Stevens' acoustic system so that it becomes production worthy for manufacturability and meets the US Navy and US Coast Guard requirements to provide maritime intruder detection characterization, classification, ease of deployment, real-time alert capability and overall low-cost.

The objectives of this SOW are to:

Stevens Institute of Technology

STATEMENT OF WORK

**Research for the Commercialization of the Passive Acoustic
Underwater Intruder Detection System**

- (1) Develop a robust, environmentally hardened, manufacturable, underwater acoustic sensor system that can detect, monitor, and classify possible intruders on the public waterways (ocean, rivers, lakes),
- (2) Develop acoustic classification algorithms to detect waterborne activity on and under the surface, including commercial and recreation traffic (powered and non-powered), and
- (3) Integrate data from the acoustic sensors and classification algorithms into field communications equipment and databases to facilitate real-time alerting capabilities.

1. PROJECT CONTEXT

The next phase of development includes building a beta version of a system with three sensor arrays and performing system testing and deployment performed in a safe, controlled environment (i.e., lower utilized river). With the phase after that being the build of preproduction units for deployment in additional test environments to ensure reliable device configuration is obtained and utilized for reliable deployments and operations.

West Virginia University, in cooperation with Inter-Modal Holding and iModalGround, LLC, is developing a Marine Research Center that includes a marine test environment on the Lower Monongahela River (Lower Mon) in north central West Virginia, including a Lock & Dam environment on the Monongahela River in Morgantown, WV. The Lower Mon can serve as a controlled, marine environment for the next level of testing of the underwater acoustic detection sensor system which needs to be qualified for US Navy and US Coast Guard considerations.

1.2 PRIOR WORK

From 2003-2013, Stevens Institute of Technology, developed and patented, Patent #US 8195409, a prototype underwater acoustic system for intruder and threat detection, characterization and classification of particular interest of the marine industry for safety, security and classification of vessels, boats, and swimmers in/around marine assets (ports, terminals, waterways, etc.) and dubbed the Stevens Passive Acoustic Detection System (SPADES). The USPTO awarded the patent on June 5, 2012 with The Trustees of the Stevens Institute of Technology named as the patent's Assignee.

Initial testing of SPADES has been performed in the United States, the UK, and the Netherlands and included underwater acoustic detection of divers and underwater unmanned vehicles, and surface boat tests of many different marine vessel types, including jet skis, pleasure vessels, pangas, GoFast, and electric boats.

This patent was licensed by the Trustees of Stevens Institute of Technology in 2012 to Sonardyne International LTD. However, that license was rescinded in 2018 since the licensee was unable to meet the agreement's manufacturing and commercialization milestones within the defined time.

Therefore, SIT plans to undertake the commercialization of this sensor by moving to the next phase of development, a beta version, that is tested to support both blue waters (oceans) and brown waters (riverways) with the oversight of the intended customer.

2 DESCRIPTION / TECHNICAL APPROACH

2.1 TASK 1 – BETA PROTOTYPE SPADES DEVELOPMENT

The objective of Task 1 is to build beta prototypes of SPADES sensor system that include 3 sensor arrays, based on the lessons learned from the previously investigated alpha prototype unit. The team

Stevens Institute of Technology

STATEMENT OF WORK

**Research for the Commercialization of the Passive Acoustic
Underwater Intruder Detection System**

will design the hardware configuration and software systems for data acquisition and processing. Hardware includes design and development of sensor array housing, mountings, deployment, or other operational accessory needs. Software includes scripts to store data from the sensor into text files or similar, to process the data for extraction of acoustic signatures, direction finding, and target localization using fusion of multi-sensor data.

At the conclusion of Task 1, the team will prepare the sensor system component specifications and final site testing plans that detail sensor configuration parameters and their ranges for field testing.

2.2 TASK 2 – BETA TEST & EVALUATION

The objective of Task 2 is to deploy the beta SPADES acoustic sensors systems developed in Task 1 to the Lower Monongahela River test site(s) for performance evaluation, parameter configuration, and preliminary data collection. The team will test each sensor array separately and in a multi-sensor configuration at two locations: (1) upriver from the Lock & Dam, and (2) down river from the Lock & Dam located in Morgantown, WV. The test area on the Lower Monongahela River has been selected as a controlled environment on the inland waterway system and provides safe and unobtrusive access for sensor deployment and testing in a brown water environment. Following this test and additional down river site, with a variety of marine traffic will be utilized for additional system validation and verification tests.

The team will deploy each beta sensor array in series at both test sites to enable direct comparison of data and results for each sensor. Arrays will be deployed during day-time hours for three one-week periods. After each day of data collection, the team will evaluate the quality of the data and fine-tune hardware and software systems. This includes determining ideal installation configuration parameters such as (1) the location of sensor array deployment, (2) the distance of the array from the marine channel. In the post processing of the recorded signal, ideal software configurations including frequency and sensitivity settings will be defined as appropriate for each sensor array and the system with 3 arrays. A minimum data collection period of 1 week will be carried out at each site for Task 2.

At the conclusion of Task 2, the team will detail the final sensor system configuration including component specifications, data output format, and parameter settings for best field operations.

2.3 TASK 3 – CLASSIFICATION MODEL DEVELOPMENT

The objective of Task 3 is to design the architecture for classification models to predict / determine vessel (powered and non-powered) classifications from data gathered by the sensor system. This includes (1) model selection, estimation, and validation, (2) data analysis, and (3) additional data collection with the sensor system. First, the team will develop a multi-sensor data fusion, feature extraction, and vessel acoustic classification prediction model based on supervised machine learning.

At the conclusion of Task 3, the team will outline an architecture for vessel classification prediction from the sensor system, present model accuracy, and create code to implement the trained model.

2.4 TASK 4 – DATA MANAGEMENT AND INTEGRATION PLAN

The objective of Task 4 is to detail data management and integration plans through coordination with the WV University (WVU) and IMG research teams. This includes creation of a Data Management Plan that can be integrated with the WVU data management plan for MMODAL for the (a) sensor data outputs and (b) classification model inputs/outputs and algorithms. The research team will work with WVU to specify element sets, real-time (or near real-time) data transfer protocols, and other data standards. Additionally, the research team will coordinate with IMG to integrate the sensor system with the communications system for near real-time data transmissions. The research team will be

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responsible for generating data transfer code/scripts in agreement with the established data management plan. It is anticipated that data from the acoustic system will be sent to MMODAL where it will then be input to the vessel classification prediction models running as MMODAL data processing tasks. At the conclusion of Task 4, the research team will produce a Data Management Plan and a data communication plan.

2.5 TASK 5 – PRE-PRODUCTION SENSOR & EVALUATION

The objective of Task 5 is to complete building or rebuilding of the beta prototype for at least three pre-production acoustic sensor arrays based on the lessons learned as a result of beta prototype tests and evaluation. The team will design / modify the hardware, software, scripts, configurations, etc. based on the results determined during Task 1 - Task 4 beta system development and evaluation.

During the two-month evaluation and observation phase, the research team will assess the acoustic sensor system for resiliency to environmental, power, and usage conditions, monitor communications, and assess model performance. The research team will work with WVU and IMG to develop a plan for observing and altering the sensor system when performance improvements are needed. This may include manual or video verification of model predictions requiring travel to the sites. At the conclusion of Task 5, the research team will prepare weekly reports on in-situ sensor performance.

At the conclusion of Task 5, the team will adjust the sensor system component specifications and final site testing plans that detail sensor configuration parameters and their ranges for field testing.

3 DELIVERABLES

3.1 PROJECT DELIVERABLES

As an end result, SIT will provide the Sponsor with a total of three underwater pre-production worthy sensor arrays to be tested in at least three different marine locations with data collected and provided to SIT.

3.2 PERIOD PERFORMANCE

The period of performance would be eighteen (18) months with the contract to start October 1, 2020 and end March 31, 2022.

4 COST ESTIMATE

The private Sponsor will pay Three Million Three Hundred Thousand and No/100 Dollars (\$3,300,000) towards the University's sponsored research program for the development of three (3) pre-production underwater acoustic detection sensor systems.

4.1 BUDGET OVERVIEW

The budget is broken down into the following categories:

Labor Costs	\$1,901,241
Parts and Supplies	\$168,237
Travel	\$45,600
Outside Services	\$10,000

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Boat Rental	\$12,000
Shipping Costs	\$3,000
Indirect Costs	\$1,159,922
Total	\$3,300,000

4.2 BUDGET JUSTIFICATIONS

See attached.

5 RESEARCH TEAM QUALIFICATIONS

Stevens Institute of Technology has been conducting research and education activities related to passive acoustic waterborne and airborne target detection and signal processing for more than 15 years. Since it was founded more than 145 years ago, technological innovation has been the hallmark and legacy of Stevens' education and research programs. Its students collaborate with more than 350 faculty members in an interdisciplinary, entrepreneurial environment to advance the frontiers of science and leverage technology to confront global challenges. Stevens is home to three national research centers, as well as joint research programs focused on critical industries such as homeland security, healthcare, energy, finance, defense and STEM education.

The Stevens team that will be contributing to this project has developed several systems for passive acoustic detection of surface, underwater, and airborne targets for the Federal Government, including the Office of Naval Research, the Naval Underwater Warfare Center, DARPA, the Air Force Research Lab, the Department of Homeland Security (Science and Technology, Customs and Border Protection, US Coast Guard, and Immigration and Customs Enforcement), and the US Army. The team members conducted several field and operational tests and received two patents for an acoustic method of underwater threat detection and for the detection of Low Flying Aircraft. In addition to the acoustic system for Low Flying Aircraft, the Stevens team developed a UAS detection, tracking and classification system. The team will use their extensive knowledge and experience gained in sensors, visualization tools, and algorithms for the execution of this project.

The following list provides a selected set of Stevens key personnel that will contribute to the proposed project. Additional team members (Research and Senior Research Engineers) will be supporting this effort.

Dr. Hady Salloum (Principal Investigator) is Professor, Director of the DHS Center of Excellence for Maritime Security, and founding Director of the Sensor Technology and Applied Research (STAR) Center. Professor Salloum has been leading key border and maritime security initiatives, including the DHS Center, Integrated Maritime Security Sensing using acoustics, radar, and IR sensors, Information Security, and other DoD and DHS projects. He has over 30 years of experience in industry and academia, running large-scale, complex research and development projects. He has directed large and complex maritime and border security experiments and field tests in intruder detection involving acoustics, infrared, video, satellite systems, maritime radar, and environmental sensing. He was the PI for numerous DHS, DoD and private company funded projects and will use his experience in the execution of this project. Dr. Salloum will be responsible for defining and leading the project for this effort, including the direction of required experiments, organization and building of the prototype, interaction with the Sponsor, report writing and presentations.

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Dr. Alexander Sutin is a Research Professor in the Civil, Environmental, and Ocean Engineering Department of the Stevens Institute of Technology. Dr. Sutin has many years of experience in physical and underwater acoustics and conducted a large number of experiments from crack detection and ultrasonic microscopy to detection, tracking and classification of large ships, small vessels, submersibles, divers, and aircraft. Dr. Sutin will provide the systems engineering and scientific support of this project. He will supervise the development of the algorithms and sensors. He will also conduct experiments, analyze the experimental results, and write the reports.

Nikolay Sedunov is a Senior Research Engineer in the STAR Center at Stevens. He has over 30 years of experience in research, development, and design in the field of electronics, radio, and microwave. His latest work includes the design and development of numerous Stevens acoustic capabilities including the patented SPADES (Stevens Passive Acoustic Detection System) and ASAD (Acousto-Seismic Air Detection) system. The Stevens system hardware for SPADES was completely designed and built by him. Before joining Stevens, he was Head of Electronics Laboratory, Radio-Physics Research Institute, Nizhny Novgorod, Russia, where he developed impulse radar and Doppler radar imaging systems for sea surface wave research and several sonar systems. Mr. Sedunov will be responsible for all hardware development connected with the project including hardware for the prototype.

Dr. Alexander Sedunov is a Senior Research Engineer in the STAR Center at Stevens. He has developed principles and software for various Stevens systems including Stevens Passive Acoustic Detection System (SPADES) and Acousto-Seismic Air Detection (ASAD) system, Acoustic Air Detection (AAD) system, the Radar and Camera Integrated System, and the Portable Acoustic Recorder System (PARS). For these systems, he developed the software for both monostatic and multistatic sensors, from target detection to localization and tracking. He also developed distributed signal processing and data fusion software for wide area sensor networks deployed in remote areas with unreliable low-bandwidth wireless communication, as well as field calibration methods and software for rapid deployment of acoustic sensors, camera cueing to target tracks, creation of scalable systems and integration with third-party hardware and software. His outstanding skills in real-time digital signal processing, embedded system development, large-scale system integration and experience in conducting laboratory and field experiments will be applied for the development of software and integration with the MMODAL system.

6 EQUIPMENT AND FACILITIES

The Stevens STAR Center and the DHS Maritime Security Center or MSC have all equipment and facilities for the successful completion of the proposed work. They have more than 30 different hydrophones and STAR researchers are currently building custom made hydrophones that are expected to provide better sensitivity for a much lower cost than COTS hydrophones. The STAR Center has more than 20 various data acquisition systems and has developed and built a number of prototypes of underwater and airborne threat detection systems.

The STAR Center also collected a large library of ship acoustic signatures using the SPADES alpha prototype that will be used in the suggested work.

SPADES is based on the acquisition and analysis of sound generated by various threats; it does not radiate any sound itself. The current version of the system uses just four hydrophones and provides simultaneous acquisition and analysis of acoustical signals. The analysis function includes arbitrary digital filtering, spectral analysis and cross-correlation for simultaneous processing of signals from several hydrophones, acoustical source separation and determination of bearing for different targets relative to the central underwater mooring. The system also records

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and stores the complete raw acoustical data set, enabling further research and analysis of the acoustic signatures.

The system components include a land-based computer and an in-water system (see Figures 1 and 2). The two sub-systems are connected via an underwater cable that provides power and communication between the two sub-systems. The Stevens Passive Acoustic Detection System is divided into two parts, underwater equipment and shore equipment. The underwater equipment consists of a set of 4 hydrophones (ITC model 6050C) arranged on a collapsible aluminum frame. A data hub is centered in this frame. Three of the four hydrophones are joined by cylindrical hubs through three ~2.4 m collapsible extruded aluminum legs arranged with 120° between each leg. All the hydrophones are connected to the central hub with BH4M SubConn wet-mateable connectors. The hydrophones and supporting frame have a weight in air of ~45 lbs. Usually the stands provide the hydrophone placement at a height of 60 cm above the bottom.



Figure 2. SPADES onboard of a boat prepared for deployment.

The mooring has a diameter of 8 inches and is 13 inches long. The weight is about 25 pounds.

The underwater equipment is connected to the shore equipment using a combined fiber-optic/electrical cable.

The software developed by Stevens was used for acoustic target detection, classification and tracking. A single SPADES node provides passive acoustic detection and line of bearing. The main method for acoustic source detection and bearing determination is based on the calculation of cross-correlation of acoustic signals recorded by various pairs of hydrophones.

For target localization and tracking, two or more such nodes are required. Each node is able to determine bearing to source of acoustic signal and find the azimuth estimate towards the target. By intersecting the bearings, two systems are able to estimate target location. Those intersections are tracked by a linear Kalman filter using multiple hypotheses tracking (MHT), which allows multiple targets to be tracked simultaneously. Those tracks can be overlaid on a map.

The developed SPADES acoustic system can detect, track and classify surface boats. Stevens deployed SPADES in the Hudson River for several months and collected thousands of acoustic boat signatures. The intensive tests were conducted on the Port of Miami, Den Helder (the Netherlands), United Kingdom, San Diego (CA), Newport (RI), and in other places.

Tests in controlled conditions with six various boats were conducted at Lake Hopatcong, NJ. The controlled conditions allowed recalculation of the boat acoustic signature at a distance of 1 m. It was achieved by comparing of the recorded vessel signal with the signal from the calibrated emitter placed at the same point where the boat signal was measured.

7 ASSUMPTIONS AND CONSTRAINTS

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**Research for the Commercialization of the Passive Acoustic
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- a. The private Sponsor will review all deliverables and give written feedback within two (2) weeks of receipt.
- b. The private Sponsor will make available staff to ensure efficient project management, testing and data collection.
- c. This project may require the parties to execute a Non-Disclosure Agreement (NDA) between SIT and the private Sponsor. If an NDA is required, the parties may negotiate and execute an NDA relative to this project and acknowledge that the process for putting the NDA in place may impact the timeline for work performance. No additional NDAs with outside parties are anticipated to be required.
- d. Tasks that require additional specification of scope, budget, and/or schedule based on the outcomes of a previous task may not start until the previous task is completed based on the discretion of both parties
- e. Some tasks may require recruitment of additional personnel and additional necessary resources. SIT and the private Sponsor will use reasonable efforts to identify such resources within a reasonable period of time. The private Sponsor acknowledges that the timing of tasks and deliverables is dependent on partner cooperation may need to be adjusted.

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- - - EXHIBIT B - - -

BUDGET JUSTIFICATION

FOR

**Research for the Commercialization of the Passive Acoustic
Underwater Intruder Detection System**

SPONSORED RESEARCH AGREEMENT

PI: Hady Salloum

Stevens Institute of Technology is requesting funding for the proposal titled “**Research for the Commercialization of the Passive Acoustic Underwater Intruder Detection System**” from October 1, 2020 to March 31, 2022 for the time period of 18 months. Salary amounts are based on actual salary and include a 3% annual cost-of-living increase for faculty, staff, part time employees and post docs, and 2% annual increase for undergraduate students and graduate students.

PERSONNEL COSTS

The definition of a year is based on Stevens Institute of Technology’s fiscal year which ends June 30.

KEY PERSONNEL:

Dr. Salloum, Director of the STAR Center is the PI on the project at Stevens Institute of Technology and will direct the research and all related activities. Dr. Salloum (36% AY effort + 2.5 summer months) will be assisted by Professor Sutin (82% AY effort + 2.5 summer months), Dr. Alexander Sedunov (98% effort), Mr. Nikolay Sedunov (98% effort), as well as a number of Research and Senior Research Engineers (5 at 98%, 1 at 18% effort). In addition, Dr. Barry Bunin will assist on a part time basis.

Total Salaries and Wages Requested: \$1,528,043

FRINGE BENEFITS:

Annual negotiations with the Office of Naval Research (ONR) result in fixed rates for Employee Benefits covering the period July 1 - June 30. The fringe benefit rate for full time faculty and other professionals is 26.2%. Fringe benefit rates for part-time employees are 8.1%.

Total Fringe Benefits: \$373,197

NON-PERSONNEL COSTS

LAB MATERIALS AND SUPPLIES:

Funds of \$168,237 are requested for the small, expendable materials and supplies that must be purchased to accomplish the stated research objectives. These include the following:

Project: Research for the Commercialization of the Passive Acoustic Underwater Intruder Detection System

Pos #	Item description	Qty	Estimated Co	Subtotal	Link
1	cDAQ-9181 CompactDAQ Chassis (1 Slot, Ethernet) Part Number: 781496-01	4	\$431.00	\$1,724.00	https://www.ni.com/en-us/shop/hardware/products/compactdaq-chassis.html?skuid=68318
2	NI 9231, 10-32 Jack, 8-Ch, +/-5V, 24-Bit, 51.2 KS/s/Ch, IEPE Excitation, AI C Series Module Part Number: 783610-01	4	\$3,054.00	\$12,216.00	https://www.ni.com/en-us/shop/hardware/products/c-series-sound-and-vibration-input-module.html?skuid=68565
3	Ethernet Extender Kit Tupavco TEX-100 Over Phone Line or CAT5/CAT6 Cable Range up to 7000ft (Pair of 2pc) LAN Network Extension over Twisted Copper Wire or RJ45 -VDSL Broadband Repeater Booster Bridge	4	\$228.00	\$912.00	https://www.amazon.com/Tupavco-Ethernet-Extender-Kit-Repeater-VDSL/dp/B01BOD8C9W
4	Airmar WS-220WX WeatherStation Instrument NMEA 0183 and NMEA 2000	4	\$1,116.48	\$4,465.92	http://www.imarineusa.com/AirmarWS-220WX.aspx
5	Airmar Weather Station USB Interface Box WS-USB	4	\$183.95	\$735.80	http://www.imarineusa.com/airmarws-usbweatherstationusbinterfacebox.aspx
6	Airmar 10 Meter NMEA0183 Standard Weather station Cable	4	\$64.38	\$257.52	http://www.imarineusa.com/airmarws-c1010meterstandardweatherstationcable.aspx
7	Axis Communications M55 Series M5525-E 1080p Outdoor PTZ Network Dome Camera BH #AXM5525E • MFR #01146-001	4	\$899.00	\$3,596.00	https://www.bhphotovideo.com/c/product/1374882-REG/axis_communications_01146_001_m5525_e_ptz_indoor_and_html
8	BUFFALO TeraStation 51210RH - NAS server - 40 TB	2	\$4,659.99	\$9,319.98	https://www.cdw.com/product/buffalo-terastation-51210rh-nas-server-40-tb/5111468?pfm=rsh
9	Precision 5540 Mobile Workstation	2	\$3,149.00	\$6,298.00	https://www.dell.com/en-us/workshop/dell-laptops-and-notebooks/precision-5540-mobile-workstation/spd/precision-15-5540-laptop/xctop554015us4
10	LG 32BL75U-W 32" LED LCD Monitor - 16:9-3840 x 2160-4K UHD - Speakers - HDMI - DisplayPort - White - Epeat Gold,Black	2	\$636	\$1,272.20	http://www8.hp.com/us/en/workstations/zbook-dock.html
11	Miscellaneous electronic and mechanical components (IC, resistors, capacitors, piezoceramic, enclosures, tripods etc)	4	\$2,500	\$10,000.00	http://www.digikey.com/
12	Networking equipment (Routers, switches, cables, etc)	4	\$500	\$2,000.00	https://www.amazon.com/s?k=network+equipment&i=electronics&ref=nb_sb_noss_2
13	Mechanical hardware and raw materials	3	\$3,000.00	\$9,000.00	https://www.mcmaster.com/
14	Intel NUC NUC10i7FNH Ultra Small Mini PC/HTPC - 10th Gen Intel 6-Core i7-10710U up to 4.70 GHz CPU, 32GB DDR4 RAM, 512GB SSD, Wi-Fi + Bluetooth, Intel UHD Graphics, Windows 10 Professional	4	\$764.22	\$3,056.88	https://www.amazon.com/Intel-NUC10i7FNH-Ultra-Small-Mini/dp/B0842W38V4/ref=rg_bs_13896591011_1007_encoding=UTF8&psc=1&refRID=QXE92CS43EG4VX066A_KN
15	Digital Yacht AIS100 AIS Receiver	4	\$166.65	\$666.60	https://www.starmarinedepot.com/digital-yacht-ais100-ais-receiver.html?gclid=CjwKCAjw3_HOBRBaEiAvLBbohRQZyBhzvkRZU3XOpWqy-Sgeek_egoByoPs_Ga2creU1BvELsLrbhoCEzQQAvD_BwE
16	Digital Yacht ANT200 Smart AIS Antenna PRODUCT ID: ZZ1095 MFG ID: ZDIGANT200	4	\$283.95	\$1,135.80	https://www.starmarinedepot.com/digital-yacht-ant200-smart-ais-antenna.html?gclid=CjwKCAjw3_HOBRBaEiAvLBbohRQZyCZWPqPhWe1RnNcODsVt-OCnAn3f1apJwp8HWfllIKQCTHD4hoCtl0QAvD_BwE
17	UBIQUITI AIRFIBER-5	5	\$999.00	\$4,995.00	http://www.microcom.us/af5.html
18	Panasonic AWUE70 Black 4K Camera, 22x PTZ with HDMI	0	\$899.00	\$0.00	http://www.fullcompass.com/prod/505273-Panasonic-AWUE70
19	Goal Zero YETI 500X 120V Portable Power Station	4	\$699.95	\$2,799.80	https://www.solar-electric.com/goal-zero-yeti-500x-portable-power-station.html
20	Goal Zero Yeti Lithium 3000 Portable Power Generator	4	\$3,199.95	\$12,799.80	https://www.solar-electric.com/goal-zero-yeti-3000x-portable-power-station.html
21	ECO-WORTHY 3000W 48V Off Grid Solar Panel Kit System with 16pcs 195W Solar Panel and 4 String PV Combiner Box and 60A Controller for Homes, RV, Boats	4	\$3,355.99	\$13,423.96	https://www.amazon.com/ECO-WORTHY-System-String-Combiner-Controller/dp/B0856ZJWML/ref=sr_1_43?dchild=1&keywords=24V+Off+Grid+Solar+Inverter&qid=1600464796&sr=8-43

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22	PHOD-1 Hydrophone	35	\$995.00	\$34,825.00	https://www.spartonnnavex.com/product/phod-1-hydrophone/
23	MAXI PRIMO CM.5901 Pneumatic Mast 9 sections without internal cable.	3	\$3,800.00	\$11,400.00	https://www.firecousa.com/products/lightweight-portable-masts/
24	HYDROPHONE CABLE WITH CONNECTORS	35	\$145.00	\$5,075.00	https://www.macartney.com/what-we-offer/systems-and-products/connectors/subconn/
25	Underwater data/ power cable , 300ft	4	\$2,500.00	\$10,000.00	https://www.macartney.com/what-we-offer/systems-and-products/connectors/subconn/
26	Tripod for MAXI PRIMO CM.5901 Pneumatic Mas	3	\$1,500.00	\$4,500.00	https://www.firecousa.com/products/lightweight-portable-masts/
27	USB harddrives for data storage and transport. WD 5Tb My Passport Ultra Blue Portable External Hard Drive, USB-C - WDBFTM0050BBL-WESN	10	\$141.21	\$1,412.10	https://www.amazon.com/WD-5Tb-My-Passport-Ultra-Portable-External-Drive/dp/B07X46C64N/ref=sr_1_21?crid=6Q0TYLK9HMFS&dchild=1&keywords=usb+hard+drive&qid=1600732275&s=electronics&sprefix=usb+ha%2Celectronics%2C150&sr=1-21
28	USB Flash Drive (1 TB) High-Speed Data Storage Thumb Stick	10	\$34.99	\$349.90	https://www.amazon.com/High-Speed-Storage-Smartphone-Pictures-Documents/dp/B08HWR594S/ref=sr_1_1_sspa?crid=1AAQJ91FTQ2P&dchild=1&keywords=usb+storage+flash+drive&qid=1600732428&s=electronics&sprefix=usb+st%2Celectronics%2C152&sr=1-1&spons&psc=1&spLa=ZW5icnlwdGVkUXVhbGImaWVvPUExMzRKM0hZNtC40EdWJmVuY3J5cHRIZElkPUJewNTU3MzM0M0RVVWkZVNtiaQzBa5C2lbnNyeXB0ZWRBZEIkUEwNiQ5NDUwMzhLVEZOSzJLWDNQmVZ3aWRnZXROYW1PXNwX2F0ZlZhY3RpB249Y2xpY2tSZWRpcmVidCZkb05vdExvZ0NsawNrPXRydWU=
Overall				\$168,237.26	

Total Lab Materials & Supplies Costs: \$168,237.26

TRAVEL:

Funds are requested to 4 people to travel during 3 three separate test periods to conduct testing and research as follows:

PURPOSE	FROM (ORIGINATING LOCATION)	TO (DESTINATION LOCATION)	# OF PEOPLE	# OF DAYS	AIRFARE	GROUND TRANSPORTATION	LODGING Total	MEALS Total	CONFERENCE FEES	TOTAL COST
Field Testing	Hoboken, NJ	Morgantown, WV	4	20	\$300	\$400	\$100	\$60		\$15,200
Field Testing	Hoboken, NJ	Morgantown, WV	4	20	\$300	\$400	\$100	\$60		\$15,200
Field Testing	Hoboken, NJ	Morgantown, WV	4	20	\$300	\$400	\$100	\$60		\$15,200

Total Travel Costs: \$45,600

OUTSIDE SERVICES:

Funds are requested to cover machine shop expenses for manufacturing the various sensor arrays. The costs are based on previous experience with such work being \$10,000.

Total Outside Services Costs: \$10,000

SHIPPING COSTS:

Funds are requested to cover shipping expenses for the various sensor arrays to and from the test locations. The costs are based on previous experience with such work being \$3,000.

Total Shipping Costs: \$3,000

Stevens Institute of Technology – Budget Justification

Project: Research for the Commercialization of the Passive Acoustic Underwater Intruder Detection System

BOAT RENTAL COSTS:

Funds are requested to cover boat rentals needed during the test for deploying and testing the sensors. The costs are based on previous experience with such work for \$1500 per day for a total of 8 days for a total of \$12,000.

Total Boat Rental Costs: \$12,000

INDIRECT COSTS:

The Institute's current negotiated on-campus F&A (indirect) cost rate is 54.2% of the Modified Total Direct Cost. The Institute's cognizant agency is the Department of the Navy, Office of Naval Research. The indirect cost base includes all costs in this budget except tuition, equipment, participant support costs, and subawards over \$25,000.

Total Indirect Costs: \$1,159,922.74

SUMMARY OF PROJECT BUDGET COSTS:

Salaries and Wages Requested	\$1,528,043.00
Fringe Benefits	\$373,197.00
Lab Materials & Supplies Costs	\$168,237.26
Travel Costs	\$45,600.00
Estimated Outside Services Costs	\$10,000.00
Estimated Shipping Costs	\$3,000.00
Estimated Boat Rental Costs	\$12,000.00
Indirect Costs	\$1,159,922.74
Total Budget	\$3,300,00.00

TOTAL PROJECT COSTS \$3,300,000

Estimates are based on the information available at the time of the proposal and may vary from actual expenses if awarded.

Payment Schedule

Option 1:

Month 1-17: \$175,000 per month

Month 18: remaining balance, \$325,000

Option 2:

Allocate the full award amount, \$3,300,000 upon execution of award